(i) Review of Flourens
on the Nervous System.

(ii) Review of Vrolik on the
Chimpanzee
&c.

(iii) Review of Albers, Kerst &c on
Morbid anatomy.
[incomplete]

ART. VII.

Recherches Expérimentales sur les Propriétés et les Fonctions du Système Nerveux dans les Animaux Vertébrés. Par P. FLOURENS, Membre de l'Académie Française, Secrétaire perpétuel de l'Académie Royale des Sciences, etc. etc. Seconde Edition, corrigée, augmentée, et entièrement refondue.—*Paris*, 1842. 8vo, pp. 516.

Experimental Researches on the Properties and Functions of the Nervous System in Vertebrated Animals. By P. FLOURENS, Member of the French Academy, Perpetual Secretary of the Royal Academy of Sciences, &c. &c. Second Edition, corrected, enlarged, and entirely recast.—*Paris*, 1842.

THE work of M. Flourens, of which this new edition has recently appeared, is well known to professed physiologists as one of the standards of their science. It appeared about the same time that the discoveries of Sir C. Bell were first made known to the world; and the reputation which it might otherwise have gained was, in this country at least, obscured by the more brilliant rays of our own luminary; but on the continent it has been more fully appreciated, and we believe that to it is mainly due the high position which M. Flourens has obtained in the scientific circles of Paris. In Britain his discoveries have been gradually incorporated with the "received text" of physiological science, without due attention to their source; and we think it but a deserved tribute to his merits to call the attention of our readers to the acknowledged merits of his former researches, as well as to notice those of more recent date and greater novelty.

The volume before us not only includes the whole of the work which appeared under the same title in 1824, together with the supplementary papers which were published in the following year, and others which have been since read before the academy, and which have been published in their transactions; but also the results of some additional researches of great interest which have been more recently made by M. Flourens. To these last we shall presently draw the more particular attention of our readers; but we shall commence by giving a general account of the results of his former inquiries, which the resumé drawn up by himself will enable us to do in his own words. It is necessary that we should explain that M. Flourens has slightly changed his phraseology since the first publication of these memoirs. The discoveries of Sir C. Bell have led him (as we anticipated, see vol. V. p. 537,) to separate more completely the properties of the *nerves* from those of the *spinal cord*. For the first he retains the term *excitability*, whilst to the latter he gives the appellation of *sensibility;* but he expressly states that by this term he means simply the power of "receiving and transmitting impressions," which is precisely Dr. M. Hall's "Reflex Function." Indeed we find a similar use of the word among the French writers in general. Thus, in one now before us,* we meet with the following passage: "All living organized beings are *sensible* or *irritable*, having the power of acting of themselves, and of reacting on the causes which tend to modify their existence. But all are not *sentient*, that is to say, they are not *conscious* of that which takes place around and within them." The term *perception*, to which we are accustomed to attach a higher notion, is the one by which French physiologists usually designate what *we* understand by *sensation*, or the *consciousness of an impression.* The following is M. Flourens's own general estimate of the tendency of his inquiries. It is to be remembered that they were *contemporaneous* with those of Sir C. Bell, and that in the following summary, therefore, these are only alluded to where they bear upon the author's own:

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* Analyse Physiologique de l'Entendement Humain. Par J. C. Collineau.

> "It was early perceived that the nervous system is at the same time the organ by which the animal receives *sensations* (impressions), the organ by which it executes or determines its *movements*, the organ by which it *perceives* and *wills*. But does the faculty of *willing* and *perceiving* reside in the same parts with the property of *feeling*? Does the property of *feeling* (receiving impressions) reside in the same parts with the property of movement? Are thinking, feeling, moving, but one property, or are they three distinct properties, having separate organs for their manifestation? These important questions, debated during so many ages, still remained for solution.
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> "My experiments showed, in a most decisive manner, that there are three essentially distinct properties in the nervous system; that of *perceiving* and *willing*, that of *feeling* (receiving impressions), and that of *moving;* that these three properties have seats as distinct as their effects; and that their organs are separated from each other by definite limits.
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> "The nerves, the spinal cord, the medulla oblongata, and the tubercula quadrigemina or bigemina, are the only immediate *excitors* of muscular contraction; the cerebral lobes are restricted to the power of *willing* this movement, and do not immediately excite them; and further, that in the spinal cord and in the nerves, the parts which *excite* movements are not the same as those which are *sensible*, and those which are sensible have not the power of exciting movement. (Sir C. Bell.)
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> "There are, then, in the nervous system three properties essentially distinct; one, that of *perceiving* and *willing;* in other words, *intelligence;* another, that of *receiving* and *transmitting impressions*, or *sensibility;* the third, that of *immediately exciting muscular contraction*, which I propose to call *excitability*. Further, there resides in the cerebellum a property, of which there had been previously no idea in physiology; and which consists in the *co-ordination* of the movements *willed* by certain parts of the nervous system, and *excited* by others. The nerve directly excites the contraction of the muscle; the spinal cord unites the separate contractions into regular movements; and the cerebellum co-ordinates these movements into the regular movements of locomotion,—walking, running, flying, &c.; whilst by the cerebral lobes, the animal *perceives* (feels) and wills." (Preface, pp. x-xiii.)

By this general statement of the opinions of M. Flourens, and the explanation of his phraseology, our readers will be prepared to follow us through his chapter on the *Laws of nervous action;* which, being itself a condensed summary of the results of his experiments, we shall translate without abridgment:

> "Three grand laws govern the action of the nervous system: the first is the *speciality* (distinctness) of action; the second is the *subordination of the nervous functions;* the third is the *unity of the nervous system.*
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> "*Speciality of nervous action.* I. It has been shown that every essentially distinct part of the nervous system has a function or mode of acting, which is equally distinct. The cerebrum does not act in the manner of the cerebellum, nor the cerebellum like the medulla oblongata, nor the medulla oblongata like the spinal cord and nerves. II. Each part of the nervous system has, then, a peculiar and special action; that is, a different action from the others; and we have further seen in what this speciality consists. In the cerebral lobes resides the faculty by which

the animal thinks, wills, recollects, judges, becomes conscious of sensations, and commands its movements. From the cerebellum is derived the faculty which co-ordinates the movements of locomotion; from the tubercula bigemina or quadrigemina, the primordial principle of the action of the optic nerve and retina; from the medulla oblongata, the motor or exciting principle of the respiratory movements; and, lastly, from the spinal cord itself, the faculty of blending or associating into combined movements the partial contractions immediately excited by the nerves in the muscles. III. The important fact of the speciality of action of the different parts of the nervous system—a fact, towards the demonstration of which the noblest efforts of physiologists were for a long time directed, is then henceforth established by direct observation, and the result demonstrated by experience.

Speciality of the nervous properties. I. There are three properties of the nervous system essentially distinct; 1, that of exciting muscular contraction, or *excitability;* 2, that of receiving and transmitting impressions, or *sensibility;* 3, that of perceiving and willing, or *intelligence.* II. And each of these properties has a distinct seat in a determinate organ. *Excitability* resides in the anterior column of the spinal cord, and in the nervous fibres which arise from it. *Sensibility* has its seat in the posterior columns of the spinal cord, and in the nerves that originate (or terminate) in it. *Intelligence* is restricted to the cerebral hemispheres.

Office of each part of the nervous system in locomotion. I. No movement is immediately derived from the will. The will is only the provoking (exciting) cause of certain movements; and is never the efficient cause of any. When an animal wills to move its arms, its leg, or any other part, it immediately moves it; but it is *not* the will which animates the muscles of the part moved, excites them to action, and combines their movements; and these functions are not performed by the cerebral hemispheres in which the will resides. II. The direct cause of muscular contractions resides particularly in the spinal cord and its nerves; the cause which co-ordinates the movement of different parts, resides exclusively in the cerebellum. III. Here then, are three distinct phenomena in a voluntary movement: 1, the willing of the movement, which resides in the cerebral lobes; 2, the co-ordination of the various parts that concur to produce this movement, which resides in the cerebral hemispheres; 3, the excitation of the muscular contractions, which has its seat in the spinal cord and its nerves. IV. Since these three principal phenomena are essentially distinct, and have their seat in three organs which are also essentially distinct, we see the possibility of abolishing one of them, the will for example, without destroying the others; or of abolishing at once the will and the co-ordination, without interfering with the contraction. V. Of this, the experiments contained in the present work afford complete evidence. An animal deprived of its cerebral lobes no longer moves spontaneously or voluntarily; but it moves with co-ordination, and quite as regularly as when these lobes are present. An animal deprived of its cerebellum, on the contrary, loses all power of co-ordinating its movements. Nevertheless all the parts of such an animal, its head, trunk, and extremities, perform movements of their own; but their motions are no longer co-ordinated, nor is a combined result obtained. Such an animal no longer walks, no longer flies, nor holds itself upright: not that it has lost the use of its legs and wings, but because the co-ordinating power no longer exists. In a word, all the partial movements still exist; but the co-ordination of these movements is lost. VI. What I have said of the cerebellum, in reference to the co-ordinate movements of locomotion, may be said of the medulla oblongata, with reference to the co-ordinate movements of conservation. Whilst this part of the medulla exists, they remain; when it is destroyed, they cease. [Under this head, M. Flourens points to the movements of respiration, deglutition, &c.] Hence their regulating principle, or *primum mobile*, has its residence there. VII. With respect to the spinal cord, its function is restricted to the union of muscular contractions, the first elements of all movements, into combined motions; and although all the nerves which determine these contractions and movements issue from it, it is nevertheless not in *it* that the wonderful faculty resides by which these contractions and movements are co-ordinated into determinate actions, such as leaping, flying, walking, running, standing, &c., or inspiration, crying, yawning, &c. This faculty resides in the cerebellum as to the former of these movements, and in the medulla oblongata as to the latter. VIII. The movements of respiration, crying, yawning, &c. are commonly termed *involuntary*, in opposition to the movements of locomotion, which are termed *voluntary.* We have just seen in what sense the term *voluntary*, as applied to certain movements, must be understood. The will is never anything else than the exciting, external, occasional cause of these movements; still it can provoke them, regulate their energy, and determine their object. Thus an animal can, at will, either move or remain still, can walk quickly or slowly, and in whatever direction it please. It is then absolute master, not of the mechanism of its movement, but of the movement itself. It is the same as to running and leaping, which are only a more rapid kind of walking; as to flying, swimming, crawling, which are only different species of progression; as to standing, which is but a part of walking; and, in a word, as to all the movements of locomotion or translation. On the other hand, respiration, crying, yawning, certain dejections, &c. only depend upon the will up to a certain point, and in certain cases. In general, all these movements take place without its either perceiving them or participating in them; and often in complete opposition to it. Lastly, the movements of the heart and intestines are absolutely and totally removed from the influence of the will. With regard to the will, therefore, as with respect to the mechanism and to the organs of movement, there are three kinds of movement essentially distinct from each other. Those of the first class are entirely under its control; those of the second are so only in part; and those of the third are not so at all.

"*Subordination of the functions of the nervous system.* I. These functions are to a certain extent under subordination to each other. II. There are, in the nervous system, some parts which act spontaneously or of themselves; and there are others which act only in subordination to the rest, or when impelled by them. III. The subordinate parts are the spinal cord and nerves; the *regulating* and *primordial* portions are the medulla oblongata, the seat of the principle which determines the movements of respiration; the cerebellum, the seat of the principle which co-ordinates the movements of locomotion; and the cerebral lobes, the exclusive seat of intelligence.

"*Unity of the nervous system.* I. Not only are all the parts of the nervous system thus mutually connected, but they are all subordinated to one organ. II. The nerves and the spinal cord are all subordinated to the encephalon; the nerves, the spinal cord, and the encephalon are subordinated to the medulla oblongata, or more precisely to the vital and central point of the nervous system, placed in the medulla oblongata. III. It is with this point, placed in the medulla oblongata, that all the other parts of the nervous system must be connected that their functions may be *exercised.* The principle of the *exercise* of nervous action passes along the nerves to the spinal cord, and from the spinal cord to this point; and, having passed this point, it moves in a retrograde direction from the anterior parts of the encephalon to the posterior, and from the posterior to this point again.

"*Unity of the cerebrum, or of the organ which is the seat of intelligence.* I. The unity of the cerebrum, or of the organ which is the seat of intelligence, is one of the most important results of this work. II. The organ, the seat of intelligence, is one. III. In fact, not only do all the perceptions, all the volitions, all the intellectual faculties, reside exclusively in this organ; but all these faculties occupy the same place in it. As soon as one of them disappears by lesion of a given part of the cerebrum, they all disappear. As soon as one of them returns by the cure of the injury, all return. The faculty of perceiving and willing, constitutes, therefore, a faculty which is essentially *one;* and this single faculty resides in a single organ." (pp. 235-44.)

We are inclined to think that, in these latter propositions, M. Flourens attaches too much importance to the medulla oblongata as a distinct and peculiar organ; but it must be confessed that there is much that yet remains to be explained in regard to the action of the brain upon the motor nerves. It may even, indeed, be questioned whether any of these nerves proceed directly from the cerebrum; and whether they have not all their real termination in the spinal cord. Upon this view, the same fibres might be excited to action either by a stimulus applied to the spinal cord itself, or by one conducted to it by an afferent nerve, or by one produced by the influence of the will through the brain; just as muscular fibre may be excited to perform the same contraction by various stimuli applied in different ways. This we believe to be the idea of Müller, though we must confess ourselves at a loss to form a definite notion of his opinions, owing to a great want of precision in the expression of them. But however it is to be explained, the *fact* that irritation of the cerebral ganglia does not in any case produce muscular movements, except when the upper part of the medulla oblongata is affected, remains as a proof that some *break* intervenes between the cerebrum and the muscle which is to be called into action; and numerous phenomena of *semi-voluntary* motion,—by which term we may designate those actions which were at first purely voluntary, but have since become more or less independent of the will through being rendered habitual by frequent repetition, such as the playing on a musical instrument,—lead to a similar conclusion.

That the cerebral ganglia are the instruments of perception, memory, the intellectual faculties, and the will, may be regarded as a position fixed by the researches of M. Flourens. That the motor principle is *immediately* derived from the spinal cord and medulla oblongata, seems also to be a legitimate deduction from his experiments; and it was by him that the principle was first brought prominently forwards, that this motor principle may be excited to action, by an external impression that does not produce sensation. The determination of the functions of the cerebellum had been previously made, without the knowledge of M. Flourens, by Rolando; and the near coincidence of the two series of results is sufficient to show that, even if neither precisely expresses the truth, neither is far from it. Similar experiments have been subsequently made by Hertwig; with corresponding results. All these experiments lead to the conclusion, that the cerebellum is the organ by which the simple motions of the several parts of the body are blended together, for the performance of the actions of locomotion, and for the balancing of the body when at rest; and this conclusion harmonises so well with the evidence supplied by comparative anatomy, as to the relative development of the cerebellum in groups of animals that are distinguished by differences in the number and variety of such combined actions, that we cannot but regard it as entitled to take rank as a physiological truth. Our phrenological readers need not imagine that the admission of this view necessarily militates against the doctrine of Gall, respecting the seat of the sexual impulse; since it is quite possible that the two functions may coexist in the cerebellum; and there are phrenologists of eminence, who have found themselves compelled by the weight of evidence to admit the truth of Flourens' views. It is not by any means a satisfactory mode of getting rid of such evidence, to say that no value can be attached to vivisections; since an animal that has undergone so severe a mutilation of its nervous centres cannot be expected to keep its balance, walk, fly, &c. For is not the removal of the cerebral hemispheres an operation of much greater severity? And yet after this, animals may live for months, standing, walking, flying, &c., but doing all as if in a perpetual sleep. M. Flourens relates that a cock from which nearly half the cerebellum had been removed, frequently attempted to have intercourse with hens in whose company he was left; showing that the sexual appetite was not destroyed by this severe mutilation. But he could never succeed, for want of power to execute the necessary combined movements, and to retain his equilibrium.

In the subsequent part of the volume we find several papers on detached subjects of much interest; but which, having been long before the public, do not now require particular notice. One of these contains the results of a series of experiments on the reunion of nerves; in which satisfactory evidence is given of the gradual restoration of function, even when large trunks have been divided; and of renewal of the nervous substance, even when a considerable portion of it has been removed. There is also an interesting paper on the movement of the brain, observed when a portion of it is laid bare in a living animal. This is shown to depend entirely upon the distension of its vessels with blood; and hence to be in part coincident with the arterial pulse, and in part with the respiratory or venous pulse.

The most remarkable novelty in the volume is that which relates to the functions of the semi-circular canals of the internal ear, and of the nerve by which they are supplied. This nerve is regarded by M. Flourens to have an office quite distinct from that of ministering to audition; and to be concerned in regulating the locomotive actions of the body. His former volume contained a memoir on the "fundamental conditions of audition," which was presented to the Royal Academy at the end of 1824. In this memoir, M. Flourens attempts to prove that the cochlea is the essential part of the internal ear; the sense of hearing not being destroyed so long as this remains entire, even though the vestibule and the semi-circular canals have been laid open and their nervous expansion completely destroyed. The laying open of the interior of the vestibule does not, according to him, perceptibly impair the acuteness of the sense, and the rupture of the semi-circular canals seems only to render hearing painful, without making it less acute, whilst it also causes very remarkable movements of the head.

Now we must remark upon the conclusions arrived at in this memoir, that they do not appear to us by any means satisfactory. The evidence of the comparative effects produced by the various operations upon the sense of hearing, is extremely imperfect, and does not appear to us to warrant the deductions which M. Flourens has drawn from it. Comparative anatomy affords much more satisfactory indications on the subject of the essential part of the organ of hearing; for, in descending the animal scale, we find one accessory part removed after another, until there remains the *vestibule* only; and this is evidently, therefore, the chief seat of the sense.

But the peculiar function of the semi-circular canals can only be determined by experiments, and those of M. Flourens are worthy of attentive study. He submitted to the commissioners of the academy, at the commencement of the year 1825, a pigeon, in which he had cut the horizontal semi-circular canal on the two sides, about two months previously. The immediate effect of the operation had been to cause a rapid jerking motion of the head from side to side, which continued with very little interruption; and also a tendency to turn to one side, which manifested itself whenever the animal attempted to walk forwards. The horizontal movement of the head, though less sudden and violent than it was immediately after the operation, still continued, and manifested itself particularly when the animal was excited to motion. The revolving action also was renewed whenever the animal was caused to move with rapidity. This revolution took place sometimes to the left, and sometimes to the right; but most frequently to the right. The movements continued with the same intensity for several months, during which period the animal retained its faculties, and being fed with care, it became very fat. Its head was then examined, and it was found that the two canals which had been cut, were obliterated at the points of section, and that no part of the train appeared to have suffered any lesion. M. Flourens has since repeated these experiments in a great variety of ways, and the results are contained in two memoirs, one, on the semi-circular canals in birds; and the other, on those of mammalia; which were read before the academy in 1828. The following is a summary of them:—Section of the horizontal canal on the two sides, in pigeons and other birds, is followed by a violent horizontal movement of the head. Section of a vertical canal, whether the inferior or superior, on both sides, is followed by a violent vertical movement of the head. And section of the horizontal and vertical canals at the same time, causes horizontal and vertical movements. Section of either canal on one side only, is followed by the same effect as when the canal is divided on both sides; but this is much inferior in intensity. In rabbits, section of the horizontal canal is followed by the same movement as in pigeons, and it is even more constant though less violent. Section of the anterior vertical canal causes the animal to make continual forward *somersets;* whilst section of the posterior vertical canal occasions continual backward somersets. The movements cease when the animal is in repose; and they recommence when it begins to move, increasing in violence as its movement is more rapid. The connexion of the particular movements, with section of the particular canals, is shown by the constancy with which the same effects follow the same lesion, in different animals.

These facts are probably familiar to many of our readers; and we merely recall them now, that the reasoning founded on them by M. Flourens in the two chapters on "the direction of the movements of the animal, governed by the direction of the fibres of the encephalon," and on the "moderating forces of the movements," which are here published for the first time, may be intelligible. These experiments were reported on to the academy by M. Cuvier, who pointed out the analogy between their results, and those which had been obtained by the experiments of Magendie, on section of the pons varolii, as well as those which the experiments of M. Flourens on the cerebellum had afforded. Injury of the cerebellum on one side, section of its crus on one side, and section of the horizontal semi-circular canal, all produce the same result; and it was natural, therefore, to infer that there is some condition common to all by which this result is brought about. This idea has been followed up by M. Flourens, who points out that each of the crura cerebelli consists of three fasciculi of fibres, which correspond to the three directions of movement:—1, The transverse fibres which embrace the medulla oblongata, forming the pons varolii;—2, The postero-anterior peduncles, which pass from the cerebellum towards the tubercula quadrigemina, forming the processus a cerebello ad testes, and becoming continuous with the crura cerebri;—3, The antero-posterior fibres, which pass backwards to the medulla spinalis, forming the corpora restiformia. Now it has been shown by experiment that if the pons varolii, containing the transverse or lateral fibres of the cerebellum, be divided, the animal rolls over sideways upon itself. If the crura cerebri, containing the anterior fibres, be cut, the animal forcibly precipitates itself forward, in the same manner as if the anterior vertical semi-circular canal were divided. And if the posterior peduncles of the cerebellum be divided, the animal tends to make a series of backward somersets, in the same manner as if its posterior vertical semi-circular canal were divided. It has been ascertained by M. Flourens that lesions of the portions of the cerebellum, from which these peduncles respectively proceed, produce the same effects. The relation to which this comparison points is certainly a very curious one.

The acoustic or auditory nerve, according to our author, is not a simple nerve, but a complex one, consisting of two essentially distinct trunks, the nerve of the cochlea, and the nerve of the semi-circular canal. The first of these is the true auditory nerve, the cochlea being (according to M. Flourens) the true seat of the sense of hearing. He assures us that he has on several occasions succeeded in destroying the cochlea of rabbits without injuring the vestibule; and that the sense of hearing was totally destroyed thereby. We must take the liberty of regarding these experiments as very unsatisfactory, since their results may be influenced by a great variety of causes; and of preferring the "experiments prepared for us by nature," who takes away the cochlea in amphibia and fishes, so that whatever power of audition these animals possess must be due to the vestibule and semi-circular canals. Still lower down in the scale the semi-circular canals disappear, and the vestibule alone remains. This is the case in some of the lowest fishes, and in the invertebrata. Let it be observed, however, that our argument does not in any way go against the peculiar function ascribed to the semi-circular canals by M. Flourens; but only to show that he has by no means established their absence of participation in the sense of hearing.

The nerve of the semi-circular canals consists of three fasciculi, each of which has a distinct origin and a distinct termination; whilst the true auditory nerve has but a single origin. One of these roots is derived from the transverse peduncles of the cerebellum; another from the anterior peduncles which enter the crura cerebri; and the third from the posterior peduncles, or corpora restiformia. These three fasciculi are distributed to the horizontal, anterior vertical, and posterior vertical canals respectively. A full account of their origin and course is promised by M. Flourens in a forthcoming work on the Anatomy of the Brain. Hence it is evidently from the nervous connexions with these parts of the encephalon, that the semi-circular canals derive the remarkable power which they have been shown to possess.

M. Flourens then goes on to inquire into the mode in which these curious movements are occasioned. He considers that it cannot be said, with justice, that section of such and such a canal, or of such and such a fasciculus of fibres, *determines* the effect, but that it rather allows it to manifest itself. For it is the *absence* of the horizontal semi-circular canal which produces the lateral movement, and its integrity seems to restrain that movement.

> "In fact, the action of the semi-circular canals, and of the fibres of the encephalon which are opposed to each other in direction, is rather an action which moderates, governs, controls, than a force which urges or determines. This force is composed of several. There are in the semi-circular canals, and in the opposed fibres of the encephalon, several forces which control and moderate; in fact, there are as many *moderating* forces as there are opposed directions of movement. Thus the anterior vertical canal, and the anterior peduncles of the cerebellum, moderate the forward movement; the posterior vertical canal, and the posterior peduncles of the cerebellum, moderate the backward movement; whilst the horizontal canal, and the lateral fibres of the cerebellum, moderate the lateral movement." (pp. 497-8.)

The nervous system, then, according to M. Flourens, is not only the *exciting principle* of the movements of the body, but is also the *regulating* and the *moderating* principle. These principles have their seat in distinct parts of the system. The *exciting* effect is produced by all those parts, which, by being pricked or irritated, immediately cause muscular contractions; that is, by the spinal cord, the medulla oblongata, and by the nerves. The *regulating* effect emanates from the cerebellum. The *moderating* effect resides in the semi-circular canals, and in the *opposing fibres* of the encephalon.

Now we are very far from being satisfied that any such new principles as those introduced by M. Flourens are required to explain what are certainly the very curious effects to which he has directed attention. It seems to us quite possible that the nerve of the semi-circular canals may be connected with the government of the motions of the body, without being the less a nerve of sense; just in the same manner as the optic nerve is connected with the *consensual* movements of the eyes, and with the contraction and dilatation of the pupil. There is undoubtedly much to be known respecting these consensual movements, which seem to be distinct from the reflex, in that they necessarily involve *sensation;* and which seem to bear a closer resemblance to those of the emotional and instinctive group. Their study, if prosecuted in a right direction, will amply repay the physiological inquirer; and he cannot do better than commence by repeating the experiments of M. Flourens, with all the precautions indicated by him, and others that will suggest themselves. We must own that we have not sufficient confidence in experiments of this kind to take upon trust the results which have been obtained by a single inquirer; for the recent history of neurological research affords abundant reason for hesitation in the reception of such results, until they have been confirmed by further inquiries, instituted by competent and unprejudiced experimenters.

Art. VIII.

Recherches d'Anatomie comparée sur le Chimpansé. Par W. Vrolik, &c. &c.—*Amsterdam*, 1841. Gr. folio, pp. 51. Seven Plates.

Researches into the Comparative Anatomy of the Chimpansé. By W. Vrolik, &c. &c.—*Amsterdam*, 1841.

This splendid monograph contains a far more extended account than had yet been published of the anatomy of that interesting group of animals which, in their conformation, most resemble man. The materials for his study, which Professor Vrolik has found in the rich museums of Holland, are such as few anatomists can command, and he has made good use of them for illustrating the anatomy of the chimpansé in comparison, not only with that of man and its immediate congeners the orang and the gibbons, especially the siamang (*Hylobates syndactylus*), but also with that of the whole race of monkeys and those of the carnivora, into whose form theirs appears to merge. We shall analyse that portion alone of the work which relates to the differences and analogies between the human form and those of the chimpansé, orang, and siamang, the three most anthropomorphous species; a subject in which, though it be not in our usual beat, few of our readers can fail to find some interest.

The first chapter relates to the *comparative osteology of the chimpansé.* The elevation of the *frontal bone* and the evenly rounded form of the head are among the most striking characters in which all the three species just named resemble man. With these, too, is connected the form of the coronal suture, which crosses over the head in a direct curve, as it almost always does in man, but which, in the lower monkeys and the animals below them, forms an angle at the vertex, the frontal bone being received into an angle formed by the two parietal bones.

The *temporal bone* is very long in the chimpansé, in correspondence with the great length of the base of the skull, and, especially of the basilar part of the occipital bone. The squamous suture is rectilinear, and is continued directly into the coronal, shutting out the ala of the sphenoid bone from contact with the parietal bone. In the orang, on the contrary, though the squamous suture is straight, the sphenoid and parietal bones are often in contact: and in this respect alone does the orang's skull generally present a more human form than the chimpansé's. The *temporal ridges* in the chimpansé and siamang are far less prominent than in the orang. In the young skull they are barely discernible, but, as age advances, they become more and more prominent and approach each other towards the top of the head. In the orang they form at last the one high ridge along the vertex of the skull, which gives it its strikingly brutal, carnivorous aspect: but in the siamang, though they give a character which contrasts strongly with that of the round smooth head of the Brahmin and Hindoo, they do not become more prominent than they are in some Caffre and Hottentot skulls. The chimpansé in regard to these ridges holds an intermediate place between the orang and siamang. Neither it, nor the orang, has either styloid or mastoid process.

Another character in which the form of all these skulls becomes, as age advances, more unlike that of the human skull, is the apparent flattening and recession of the forehead in consequence of the increasing prominence of the superciliary ridges, and through the growth of the face being, even more than it is in man after the period of childhood, more rapid than that of the skull. The increase is shown especially in the growing prominence of the jaws; it is greatest in the orang, least in the chimpansé. To this enlargement of the jaws is due the length and narrowness of the palate, and also, in great measure, the backward position of the *foramen magnum*, and the occipital condyles. In man these parts are placed so near the centre of the skull that but little force is needed for maintaining the head erect; but in even these highest monkeys they lie in the posterior third of the base of the skull, and thus, so far back that a peculiar arrangement of the cervical vertebræ is needed for the support of the head.

The *nasal bone* in both the chimpansé and the orang are generally single, long, and narrow: in the former, their border is, as in man, somewhat raised: in the siamang there is also but one bone in the adult state, but it is shorter and wider than in either of the other species. In conjunction with this, the inter-orbital space is, in the siamang, wider and more man-like than in any of its congeners. The orbits themselves are in all placed high up, and proportionally larger, though less deep, than in man.

The *intermaxillary sutures* in the chimpansé are obliterated very early, and sooner than they are in the orang; and the anterior palatine foramina are, as in man, close to the roots of the incisor teeth: the palatine suture remains to the adult state.

The *lower jaw* of the chimpansé is large and long, but the chin is prominent and forms a less obtuse angle than in the lower animals: in the orang the jaw is still longer and the chin less prominent: in the siamang the chin is vertical and round, the angle of the jaw is nearly a right angle, and its coronoid process is but little elevated. In all these characters, as well as in the proportionally greater width and less prominence of the face, and in some other external characters of the skull already mentioned, the siamang approaches nearer to the human form than either the chimpansé or the orang.

The teeth are long and large in all these species, and especially in the orang: and in none of them do they form a continuous series. There is, in all, a space by the side of each canine tooth into which the corresponding tooth of the other jaw is received; a character so connected with the mode of life and nature of the food, and, through these, with corresponding peculiarities of other parts, that it may be justly regarded as establishing a generic difference between them and man; understanding by that expression a difference as great as that which exists between any kinds of animals which naturalists are agreed to place in different genera.

In the *vertebral column* of the chimpansé the chief differences are as follows:—the spinous processes of the cervical vertebræ are directed straight backwards and not bifurcated; there are thirteen dorsal vertebræ; the transverse processes of the lowest (the fourth) lumbar, are joined to the ilia: only the upper two and a part of the third sacral vertebræ enter into the formation of the sacro-iliac symphysis: the promontory of the sacrum is but little marked, and its anterior surface is not hollowed.

The *pelvis* of the chimpansé differs more importantly. It is directed in the line of the axis of the trunk: the alia are long, straight, and vertical, concave on their posterior (outer), and convex on their anterior (internal), surface: and hence the upper strait of the pelvis is narrow and elongated, and in a horizontal front view one can see the whole length of the sacrum and coccyx. The anterior inferior spine of the ilium is absent; the symphysis pubis very deep; the angle very acute; the tuberosities of the ischii are on almost the same level as the lower edge of the symphysis pubis, and are large, flat, triangular, and curved outwards.

The orang's vertebral column is less like that of man, especially in the great length of the spinous processes of the cervical vertebræ, their direction straight backwards or even, in those below the third, somewhat upwards, in adaptation to the weight of the head naturally hanging forwards. The cervical part of the siamang's spine is more man-like, but still is widely distinguished by the characters of its spinous processes. The orang has but twelve dorsal vertebræ; in which respect it is nearer to man than either the chimpansé or the siamang, for both of them have thirteen. The spinous processes of the upper dorsal vertebræ are, in both the orang and the siamang, unlike those of the chimpansé, directed straight backwards. The lumbar vertebræ of the orang and siamang are four in number, and are distinctly different from those of man in their articular processes being not vertical, but inclined obliquely outwards, so that they are not capable of that characteristic movement in a quadrant which is adapted to the biped gait of man.

The sacrum of the siamang is more man-like than that of the orang or chimpansé, inasmuch as all its four false vertebræ are united in one bone, which is short, broad above and gradually tapering downwards, but forms only a slight promontory, and wants the excavations, both vertical and transverse, which the human sacrum presents. In like manner, the whole pelvis of the siamang has, of those of the three species, most nearly human form, and approaches closely to that of the Bosjes-woman, of which the elder Vrolik has, in his well-known work on the national forms of the pelvis, given so complete an account. The ilia are very broad above; hollowed out on their anterior surface; and have a rounded crest and a rudiment of an anterior inferior spine. The horizontal rami of the ossa pubis form a well-marked crest, and their symphysis is narrower and more oblique than in the other species. The rami of the ischia, moreover, are not transverse, but are directed obliquely towards the ossa pubis, as in the human skeleton; their tuberosities and spines are large; and on the posterior aspect of the ilia there is the same sinuous surface as that of man presents.

The *thorax* has a greater width and a more rounded form, as one ascends from the lower monkeys towards man. The sternum in the chimpansé has a general resemblance to the human form, but its superior border has not a transverse notch, and the three pieces, analogons to those which compose the second portion of the sternum of man, remain separate. In the orang, the sternum is shorter and broader; and, up to a certain period of life, is composed of separate and symmetrical portions, of which five on each side are connected at the middle line. The two portions of the manubrium unite first, and the union seems to proceed from above downwards; but in the skeleton of even an old orang, at Leyden, it has not taken place in the two lower portions. In the siamang the portions of the sternum unite earlier than in the orang; but it is widely distinguished from that of man by its breadth and shortness.

The *anterior extremities* of all the three species differ greatly from those of man in their length, as compared with that of the posterior extremities. In the erect human skeleton the fingers reach the inferior third of the femur; in that of the chimpansé they reach the upper third of the tibia; and in those of the orang and siamang they touch the feet. And while in man, as he advances from the fetal period, the lower extremities grow proportionally more in length than the upper, in these apes the case is reversed, and the disproportionate length of the upper extremities increases with their years.

The chimpansé's *clavicle* has the sigmoid arch of that of man, but in an exaggerated degree. Its scapula is elongated, has a rounded posterior border, and a very obtuse inferior angle; its spine is almost perpendicular to the plane of its posterior surface, and is directed nearly parallel to the axis of the trunk; and its acromion is larger and narrower than that of man. In the orang, the clavicles are less curved than in the chimpansé—in the adult, indeed, they are nearly straight; and in the siamang the sigmoid curve is not present. In the orang, however, the scapula is broader and its spine is not so nearly perpendicular to its surface; while, in the siamang, the form of this bone approaches more nearly to that which it presents in the chimpansé.

The chimpansé *humerus* has pretty nearly the human form, but is longer and stronger. The same comparatively greater length is found in the *radius* and *ulna*, which are, moreover, more curved in opposite directions than those of the human skeleton are, so that the interosseous space is very wide. Nearly the same characters are found in the corresponding bones of the orang and the siamang.

In the chimpansé the *carpus* has eight bones like those of man, except that the trapezium and trapezoid are proportionally small, the pisiform large. The trapezium, too, though placed in the same line as the others, is not turned so much backwards as it is in man, and hence the thumb, though more separated from the fingers than it is in the other quadrumana, is far less so than in the human hand. The carpus of the orang, besides having the pisiform bone sometimes divided into two, (a condition observed by Mr. Owen, but not by Vrolik,) has *nine* bones; and in this, more strikingly than in any other osteological character, the orang stands nearer to the lower monkeys than the chimpansé does. The ninth bone, which it was reserved for Vrolik to discover, even in the field which had been already traversed by Owen and De Blainville, is the *os intermedium* observed by Cuvier in the carpus of the lower apes, and described by De Blainville as common to all the other quadrumana, but hitherto unnoticed in the orang. It lies between the two rows of the carpal bones, like a separated portion of the scaphoid, which it nearly resembles in form, and it articulates with the trapezoid, scaphoid, lunar, and os magnum.

The *hand* of the chimpansé differs from that of man in the length and narrowness of its palm, the length of the phalanges (especially the last) of the fingers, their curvature, and the existence of ridges along the palmar edges of the first and second phalanges: but, much more obviously, in the shortness and slenderness of the phalanges of the thumb, which, though it is placed so that it can be fully opposed to the fingers, is rudimental in comparison with that of man. In the orang these distinctive characters are still more marked; and, besides, the metacarpal bone of the middle finger is longer than that of the index. In the siamang, the hand approaches somewhat nearer to the human form, inasmuch as the bones composing the thumb are neither so short nor so slender as they are in the chimpansé and the orang.

The peculiarities of the *inferior extremities* of the chimpansé are, in general, their shortness when compared with the superior. In particular, the head of the *femur* is fixed to the acetabulum by a *ligamentum teres*, a part which is deficient in the orang, though present in some other apes. The *tibia* and *fibula* are both curved in opposite lateral directions; the *patella* is small; and the fibular portion of the ancle-joint is directed somewhat downwards in correspondence with the inward aspect of the sole. The *os calces* is thinner and weaker than in man, but directed straighter backwards than in other apes. The *scaphoid* and internal *cuneiform* bones are placed obliquely, so that the metatarsal bone of the great toe is not on a level with the others. The *great toe* is proportionally larger and less like a thumb than in other apes; its metatarsal bone is shorter and stronger than the others; and the middle toe is the longest of all. The whole sole of the chimpanse's foot is narrower than that of man, and the phalanges of all the toes are longer; but in all these respects the chimpansé differs less from man than any of its congeners.

In the orang, the femur is shorter and much less curved anteriorly (at least in the adult) than it is in man and the chimpansé. The tibia is much curved inwards, but the fibula is nearly straight: the internal malleolus is short and weak, the external is not pointed : the tibio-tarsal articular surface is not concave but slightly convex ; and, from these conditions, the ancle-joint is much more moveable, but, at the same time, less strong than it is in man. The tarsus is large. The upper articular surface of the astragalus is inclined from without inwards; the anterior is very small and also directed obliquely inwards. The os calcis is very thin and curved outwards, as in a human club-foot; the scaphoid bone is broad, but thin; the cuneiform bones are all small, especially the internal one, of which the metatarsal articular surface is too short to reach the ground, and is so directed that the great toe must be separate from the others: the metatarsal bones are very long and inclined obliquely outwards (instead of inwards as in man,) and that of the second toe is shorter than that of the third, while, in man, the former is the longest of all. The first phalanges of the four lesser toes are much curved, and are swollen in the middle of their shafts; the second phalanges are less curved, but are also swollen ; the third are long and narrow. The hallux has a short, straight, and slender metatarsal bone, and two phalanges, or, sometimes, only one, which is straight and pointed ; and, if the foot be put upon the ground, the metatarsal bones of the second and third toes rise up, and the curved phalanges are turned inwards. In numerous and striking characters, therefore, the foot of the orang differs from that of man even more widely than that of the chimpansé does.

Such are the comparative osteological characters of man, and the three most anthropomorphous apes. Our abstract of them is so brief that we could scarcely make a briefer summary. It is evident enough from them that, according to the ordinary rules of classification, the difference is sufficiently great to justify the placing man, not in a separate genus only, but in a separate order; and of the three species the chimpansé deserves the place next to man, which Cuvier assigned to the orang. We now pass to the second chapter, which is devoted to the myological description of the chimpansé. We shall point out only the characters in which it clearly differs from man, leaving it to be understood in general that in the particulars not mentioned their conformations are similar.

Of the *muscles of the neck*, the platysma myoides forms one broad and strong muscular layer, extending from the sides of the cheeks over the whole front of the neck to the upper part of the shoulders and chest. The anterior belly of the digastricus is very large. The genio-hyoidei are proportionally stronger, and the mylo-hyoidei thinner than in man: but, as to arrangement, there is no difference in either these or the adjacent muscles of the hyoid bone. The latissimus dorsi is arranged as in man, but, near its insertion there proceeds from the lower margin of its aponeurosis a muscular fasciculus, which descends along the inner border of the triceps, and is attached by a broad tendon to the inner condyle and the olecranon. Near the levator anguli scapulæ there is a muscle (*levator claviculæ* Tyson,) which arises from the transverse processes of the second and third cervical vertebræ, and is attached to the scapular portion of the clavicle, not far from the coracoid process.

The *abdominal* and *lumbar muscles* are exactly like those of man. Of those of the *chest*, the pectoralis major alone differs, in that its sternal and clavicular portions are not separated: (in the orang there is no clavicular portion.)

In the *muscles of the arm*, a fasciculus is given off from the inner edge of the coraco-brachialis, and joins the edge of the triceps. The outer portion of the brachialis anticus is disproportionately large. The muscles of the fore-arm are hardly distinguishable from those of man. In the muscles of the fingers there is the same degree of similarity, and in those of the thumb, the chimpansé exhibits the same superiority over the orang as it does in the bones of that member. All those which are described in man exist in the chimpansé, with the exception of the flexor longus pollicis; and they differ in little, except in being smaller and weaker. The same may be said of the muscles of the little finger.

In the *muscles of the lower extremity*, there are greater deviations from the human form. The psoas is comparatively slender; the iliacus long and narrow. The sartorius is long and remarkably wide at its lower end: it terminates by expanding into a broad aponeurosis which is attached to the inner surface of the upper part of the tibia. The gracilis also is, comparatively, very wide; the pectineus broad and long; but the quadriceps extensor is hardly different from that of man. The glutæus maximus is very narrow, thin, and small; and it descends lower than it does in man, reaching towards the inferior third of the thigh; whence the almost complete absence of buttock in the chimpansé, and of that horizontal fold which divides the human buttock from the thigh. The glutæus medius, on the other hand, is large and strong, and nearly the whole of its surface is exposed. (The other muscles of the buttock could not be dissected.) The points of insertion of all the flexor muscles of the leg are much lower than in man, and the tendon of the semitendinosus is shorter and larger. The adductors differ only in the large size of the adductor magnus.

The tibialis anticus of chimpansé is a remarkably large muscle. It is composed of two fasciculi, of which the internal corresponds with the human tibialis anticus, and is inserted into the internal cuneiform bone, while the external arises from the head of the fibula, descends by the side of the internal one, passes under the annular ligament, and is inserted into the proximal extremity of the metatarsal bone of the great toe. This arrangement is adapted to the vigorous action of the great toe, to which the fasciculus serves as an abductor; and, in correspondence with it, the fasciculus of the extensor brevis digitorum which is appropriated to the same member is separated from the rest and peculiarly large. There is no peroneus tertius, and the peroneus brevis is broad and strong.

The gastrocnemii descend low down the leg of the chimpansé to the short and broad tendo achillis, and form no abrupt and prominent calf. The soleus arises by a horizontal line from the posterior surface of the tibia, and is not fixed to the tendo achillis till near the os calcis. The flexor longus pollicis is very strong, and larger than either of the other deep muscles of the back of the leg: the abductor pollicis, also, is proportionally large, and the flexor brevis and adductor pollicis are both well developed.

The arrangement of the *muscles of the sole* is very remarkable. Immediately under the skin there is a strong muscular fasciculus, the analogies of the flexor brevis and flexor accessorius digitorum, which occupies a great part of the sole, arising from the os calcis, and passing to a tendon for the middle toe, and some other tendinous bands. Above it is the tendon of the flexor longus digitorum, which divides into several smaller tendons; and upon these are four lumbricales which go to the tibial borders of the first phalanges of the second, third, fourth, and fifth toes. From these tendons there proceeds in the first place an aponeurotic prolongation towards the second toe, on arriving at which it separates into two parts, of which one, dividing, is attached to the borders of the second phalanx, while the other passes along the middle of the toe to the third phalanx. For the middle (third) toe, there are, first, the principal tendon of the flexor brevis, which, dividing, is attached to the sides of the second phalanx; and secondly, the tendon from the flexor longus hallucis, which passes between the two portions of the former to the third phalanx. For the fourth toe, in like manner, there are two tendons; one from the flexor longus digitorum, which bifurcates and is attached to the borders of the second phalanx, and another from the flexor longus hallucis which passes along the middle to the third phalanx. The fifth toe, on the contrary, has only the one tendon from the flexor longus digitorum. Thus, the muscle corresponding to the human flexor longus pollicis gives tendons to three toes, viz. the first, third, and fourth; and there is a tendon for each phalanx of the second, third, and fourth toes; the first phalanges receiving the tendons of the lumbricales, and the second and third those of some of the three other flexor muscles. The little toe, besides its tendon from the flexor longus, has a flexor brevis and an abductor muscle like those of man.

In the third chapter Vrolik compares, at considerable length, the muscles of the champansé with those of the gibbon, orang, several species of macacus and loris, kangaroo, opossum, lion, bear, unau, utia, and zebu; all of which he has himself dissected, and of which his descriptions form part of the materials from which he proposes to publish, at some future time, a complete comparative myology. But, important as the chapter is, it is beyond our present design; and we proceed to the fourth, which contains the

Comparative neurology of the chimpansé. The brain of the specimen dissected by Vrolik was unfortunately decomposed; so, for a kind of compensation, he has given an excellent sketch of a vertical section of the brain of an orang, by which he has completed "the phrenological iconography" of that species, which the works of Sandifort and Tiedemann had, in this respect, left imperfect. His plate exhibits a character of difference from the human brain, which had not hitherto been pointed out; namely, that the corpus callosum, whose posterior border corresponds, in man, to the testes, does not, in the orang, reach even so far back as the nates.

The description of the chief branches of the spinal and of some of the cerebral nerves is nearly complete. The vagus, glosso-pharyngeal, and hypoglossal nerves have almost exactly the same arrangement as in man; but there is an important peculiarity in the accessorius. After leaving the skull it divides, as in man, into an external and an internal branch: the external is distributed almost exclusively to the trapezius muscle; and the internal, instead of joining the trunk of the vagus, passes separately to the larynx, which it enters above the os hyoides. We cannot say what important evidence this fact affords for Bischoff's and Longet's view that the true motor nerve of the human larynx is the accessorius which sends its fibres to that organ through the medium of the vagus.

The arrangement of the cervical nerves of the chimpansé is identical with that in man; and nearly the same may be said of the nerves of both the upper and lower extremities, which do not present one important peculiarity.

There is the same similarity in the arrangement of the blood-vessels, which are described in the fifth chapter; and it extends even to the existence of three trunks arising from the arch of the aorta, in which (as far as is yet known,) the chimpansé and the orang alone resemble man.

The sixth and last chapter is devoted to the comparative splanchnology, and especially to the account of the larynx and laryngeal pouches. Of the latter, Vrolik proves, by the comparison of those of numerous species of monkeys, that they regularly increase in size with advancing age, and that, in general, they are larger in males than in females. He discusses also their probable purpose, and concludes that they are not intended to modify the voice, but for reservoirs of air to diminish the specific gravity of the animal, and thus to facilitate the climbing and almost bird-like movements of some of the species.

Of the other viscera, the heart and lungs are entirely like those of man; the liver is very large, and has no groove for the passage of the inferior cava; the gall-bladder resembles a tortuous duct rather than a bladder; the spleen is elongated with an inferior caudal prolongation; the stomach has the human form; the cæcum has an appendix vermiformis differing from that of the orang, in that it is separated from the cæcum by a constriction, as it is in man. The urinary organs present no peculiarity.

The value of this new proof of Dr. Vrolik's industry and knowledge may be estimated from this abstract, but we cannot justly conclude without a remark on the manner in which the work is executed. The plates, engraved on stone from nature by two Dutch artists, C. G. R. Meyer and E. Taurel, are not only exact in anatomical details, but are some of the most beautiful specimens of lithography that we have ever seen: those of the skeleton and of the abdominal muscles might be taken for models by any anatomical artist. The printing and the whole style of the work are equally admirable; they are such as are rarely seen in England, except in a few books printed by rich public bodies.

ART. IX.

1. *Beobachtungen auf dem Gebiete der Pathologie und Pathologischen Anatomie, gesammelt von* Dr. JOH. FRIED. HERM. ALBERS, Professor der Medezin, &c. in Bonn. Dritter Theil.—*Bonn*, 1840. 8vo, pp. 195.

Observations on the Department of Pathology and Pathological Anatomy, collected by Dr. J. F. H. ALBERS, Professor of Medicine, &c. at Bonn. Third Part.—*Bonn*, 1840.

2. *Waarnemingen in het Gebied der Pathologie an der Pathologische-Anatomie.* Door Dr. J. F. KERST, Chir. Mazoor, &c.—*Utrecht*, 1839. 8vo, pp. 214.

Observations in the Department of Pathology and of Pathological Anatomy. By Dr. J. F. KERST, Surgeon-major, &c.—*Utrecht*, 1839.

3. *Bijdrage tot de Ontleedkundige Ziektekennis.* Van F. S. ALEXANDER, Med. Doct. en Prof. to Utrecht.—*Gorinchem*, 1835. 8vo, pp. 38.

Contributions to Anatomical Pathology. By F. S. ALEXANDER, M.D., and Professor of Medicine at Utrecht.—*Gorinchem*, 1835.

I. THE first part of Professor Albers' work was noticed in our Fifth Volume, and we have often, both before and since, had occasion to speak of his writings.* Yet there has seldom been reason to praise the results of his labours; for though there is much accuracy in his descriptions of what he actually sees, yet there is a want of discernment of the differences in the things which he investigates, and an unwarrantable freedom in generalizing from a few facts, which entirely neutralize his claim to merit. The present series of essays clearly demonstrate both these faults.

The first essay is "*on the simple ulcer of the stomach*," which commonly terminates by perforation of the walls of that organ, and fatal peritonitis. On the morbid anatomy of the disease nothing is said beyond what is generally known. The author enters at some length into the diagnosis of its early progress; and his remarks might have been quoted, had he not seemed so much more definite than he is warranted in being by the evidence before him, as to excite suspicion that he speaks rather from what the morbid anatomy of the disease suggests of its progress during life, than from actual observation of the signs of its course. On the experience of only five cases he describes the disease as passing with well-marked characters through several distinct stages; and omits to notice, as if he were ignorant of the fact, that its existence is often not testified by any symptom whatever, till the perforation takes place.

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* See vol. II. p. 535; vol. III. pp. 220, 246; vol. VIII. p. 544; vol. IX. p. 445.

The second paper is "*on somnambulism*, and will be noticed elsewhere. The third is "*on dilatation of the bronchi forming cavities;*" but it contains nothing with which English readers are not familiar. The fourth relates to "*encysted tumours in the perichondrium of the thyroid cartilage.*" It contains a description of two preparations, in each of which that part was occupied by a tumour nearly an inch long. In one the tumour was composed of a fibrous tissue in concentric layers inclosed in a dense fibrous capsule; in the other it consisted of a cyst half a line thick, containing a cellulo-fibrous, and a granular, pultaceous substance. The author compares these growths with one of a similar kind found within the larynx, and described in the first part of his work.

The fifth essay relates to a case in which a fluid containing fibrine, and separating after its removal into serum, and a coagulum was drawn from the interior of the abdomen. But there is no evidence to show what was its source.

The title of the last and longest essay is "*on hyperostosis, osteoporosis, and exostosis.*" Here, again, we think it unadvisable to notice the author's account of the signs of the diseases he describes; for there is no reason to believe that he observed them during life. On the contrary, he acknowledges that he is acquainted with the appearances of the diseased parts only through the old preparations in the Bonn Museum, and a few examinations made soon after death. Perhaps too his morbid anatomy might as summarily be passed over; but in pointing out his errors, some useful truth may be told.

His primary division of hyperostosis is into hypertrophy of the medulla, or *osteomyelosis*, and hypertrophy of the compact tissue of bone, or *hyperostosis* properly so called.

In his account of the first he confounds two distinct affections; rickets, and atrophy of bone. He speaks of the excessive fat being modified so as to be of a "dark dirty red, yellow, or even ash-gray" colour; and says he found it thus in the interior of the femur of a rickety child. Now the material here described is not fat, but a peculiar gelatinous substance which occupies large spaces formed in the cancellous tissue of rickety bones, and in its general aspect resembles soft provisional callus. This therefore is not hypertrophy of the medulla, nor does it bear any relation to that which is rather less improperly so called. Of this the author says, that the medulla either is very consistent and exactly fills all the cavities, (which, we think, is only what is healthy in a fat man;) or, "the wall of the bone has at the same time diminished, and the osseous lamellæ which form the cells of the medullary membrane, are become thinner and have decreased in numbers. I could," he adds, "in one case remove the medulla out of the cavity without any trouble whatever, and I found only a few lamellæ forming cells; yet the femur belonged to an adult man, who died apoplectic." The description is very accurate, but the change is no hypertrophy; it is the usual condition of bones which have been atrophied through disuse, either because the patient has

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